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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,922	10/01/2003	David E. Lowell	200309154-1	8294
<div>22879      7590      06/04/2007</div> <div>HEWLETT PACKARD COMPANY P O BOX 272400, 3404 E. HARMONY ROAD INTELLECTUAL PROPERTY ADMINISTRATION FORT COLLINS, CO 80527-2400</div>				
			<div>EXAMINER</div> <div>WAI, ERIC CHARLES</div>	
			<div>ART UNIT</div> <div>2195</div>	<div>PAPER NUMBER</div>
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	Application No. 10/676,922	Applicant(s) LOWELL, DAVID E.	
	Examiner Eric C. Wai	Art Unit 2195	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 01 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-66 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-66 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

1. Claims 1-66 are presented for examination.

***Claim Rejections - 35 USC § 101***

2. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 47-66 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

4. Claims 47 and 56 recite an "article"; however, it appears that the article would reasonably be interpreted by one of ordinary skill in the art as software, per se, failing to be tangibly embodied or include any recited hardware as part of the system.

***Claim Rejections - 35 USC § 112***

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 7-9, 29-46, and 56-66 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- a. The following terms lack antecedent basis in the claims:

- i. Claim 7, "the I/O accesses".
- ii. Claim 9, "the state of a state machine".
- b. The following terms are not clearly understood:
  - iii. Claims 29 and 38 recite, "computer memory encoded with a virtual machine". It is unclear how memory can be "encoded" with a virtual machine.
  - iv. Claim 56 recites, "the article comprising software". It is unclear how the article can "comprise" software.

***Claim Rejections - 35 USC § 102***

27. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

28. Claims 1-8, 10, 12-14, 16, 29-34, 36-37, 47-51, and 53-55 are rejected under 35 U.S.C. 102(b) as being anticipated by Bugnion et al. (US Pat No. 6,075,938 hereinafter Bugnion).

7. Regarding claim 1, Bugnion teaches a computer including an I/O device, a method comprising using a virtual machine monitor to commence virtualization of the I/O device at runtime (col 2 lines 36-40).

8. Regarding claim 2, Bugnion teaches that the computer further includes a CPU, wherein the virtual machine monitor is in control of the CPU prior to the runtime virtualization of the I/O device (col 2 lines 36-40, wherein it is inherent that the VMM must virtualize the resources).

9. Regarding claim 3, Bugnion teaches that the virtualization is performed transparently to the operating system (col 6 lines 17-20).

10. Regarding claim 4, Bugnion teaches that the I/O device is compatible with the virtualized I/O device (col 6 lines 17-20, wherein they must be compatible in order for the virtualization to be transparent).

11. Regarding claim 5, Bugnion teaches that the virtualization includes commencing I/O device emulation at runtime (col 10 lines 1-2).

12. Regarding claim 6, Bugnion teaches configuring the hardware to trap I/O accesses, and enabling the virtual machine monitor to emulate the I/O device in response to the traps (col 11 lines 31-34).

13. Regarding claim 7, Bugnion teaches that the virtual machine monitor uses memory management to trap the I/O accesses (col 11 lines 31-36).

27. Regarding claim 8, Bugnion teaches that the virtual machine monitor can commence the emulation between I/O sequences (col 14 lines 32-42).

28. Regarding claim 10, Bugnion teaches that the virtual machine monitor can commence the emulation in the middle of an I/O sequence (col 14 lines 32-42).

29. Regarding claim 12, Bugnion teaches that the runtime virtualization includes using the virtual machine monitor to emulate I/O device interrupts (col 11 lines 48-49).

30. Regarding claim 13, Bugnion teaches that the I/O device interrupts are directed to the operating system prior to the runtime virtualization of the I/O device (col 2 lines 57-59); and wherein the I/O device interrupts are directed to the virtual machine monitor during and after the virtualization of the I/O device (col 11 lines 48-49).

31. Regarding claim 14, Bugnion teaches that the virtual machine monitor temporarily pauses an I/O sequence by emulating the I/O device as being busy (col 3 lines 8-10).

32. Regarding claim 16, Bugnion teaches devirtualizing the I/O device at runtime following the runtime virtualization (col 11 lines 17-19).

Art Unit: 2195

33. Regarding claims 29-34, and 36-37, they are the computer claims of claims 1, 4-7, 10, 12, and 14 above. Therefore they are rejected for the same reasons as claims 1, 4-7, 10, 12, and 14 above.

34. Regarding claims 47-51, and 53-55, they are the article claims of claims 1, 5-7, 10, 12, and 14 above. Therefore they are rejected for the same reasons as claims 1, 5-7, 10, 12, and 14 above.

***Claim Rejections - 35 USC § 103***

35. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

29. Claims 9, 11, 15, 35, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bugnion et al. (US Pat No. 6,075,938).

36. Regarding claim 9, Bugnion teaches that the virtual machine monitor commences emulation by intercepting I/O accesses (co 14 lines 32-34).

37. Bugnion does not teach that the virtual machine monitor uses the intercepted I/O accesses to change the state of a state machine, whereby the state machine reflects the state of the I/O device; and wherein the virtual machine monitor examines

transitions in the state of the state machine to determine whether the I/O device is in the middle of an I/O sequence.

38. It would have been obvious to one of ordinary skill in the art at the time of the invention to include the use of a state machine. One would be motivated by the desire to have a method of representing the state of the I/O device to track its operation.

39. Regarding claim 11, Bugnion does not teach that the virtual machine monitor uses a state machine to determine whether the I/O device is in the middle of an I/O sequence, and delays commencing emulation until the state machine indicates that I/O sequence has completed.

40. It would have been obvious to one of ordinary skill in the art at the time of the invention to include the use of a state machine. One would be motivated by the desire to have a method of representing the state of the I/O device to track its operation. It also would have been obvious to delay commencing emulation. One would be motivated by the desire to not interrupt the I/O sequence.

41. Regarding claim 15, Bugnion does not teach that the I/O device has multiple modes of operations; wherein the virtual machine monitor determines the mode of the I/O device prior to commencing virtualization; and wherein the virtual machine monitor restores the determined mode of the operation after virtualization.

42. It would have been obvious to one of ordinary skill in the art at the time of the invention that I/O devices have multiple modes of operations. It also would have been



Art Unit: 2195

obvious to restore a previous mode of operation after virtualization. One would be motivated by the desire to ensure that the virtualization proceeded transparently as indicated by Bugnion (col 6 lines 17-20).

43. Regarding claims 35 and 52, they are the computer and article claims of claim 11 above. Therefore, they are rejected for the same reasons as claim 11 above.

44. Claims 17-28, 38-46, and 56-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bugnion et al. (US Pat No. 6,075,938) in view of Kozuch et al. (US Pub No. US 2002/0083110 A1 hereinafter Kozuch).

45. Regarding claim 17, Bugnion teaches a computer including hardware, a virtual machine monitor running on the hardware, an operating system running on the virtual machine monitor, the hardware including an I/O device, the I/O device already virtualized by the virtual machine monitor (col 2 lines 36-40).

46. However, Bugnion does not teach devirtualizing the I/O device at runtime. Kozuch teaches devirtualizing resources when a VMM becomes idle ([0027] lines 7-11).

47. It would have been obvious to one of ordinary skill in the art at the time of the invention, to include devirtualizing the device at runtime. One would be motivated by the desire to conserve power as indicated by Kozuch ([0027] lines 1-5).

Art Unit: 2195

48. Regarding claim 18, Bugnion and Kozuch do not explicitly teach that the devirtualization is performed transparently to the operating system.

49. It would have been obvious to one of ordinary skill in the art at the time of the invention that the devirtualization is performed transparently. One would be motivated by the desire to perform the devirtualization transparently since the virtualization was also performed transparently.

50. Regarding claim 19, Kozuch teaches that the devirtualization includes stopping I/O device emulation at runtime ([0027] lines 7-11).

51. Regarding claim 20, Bugnion and Kozuch do not teach that the devirtualization includes allowing the virtual machine monitor to temporarily stop the operating system from commencing a new I/O sequence.

52. It would have been obvious to one of ordinary skill in the art at the time of the invention to include temporarily stopping the OS from commencing a new I/O sequence. One would be motivated by the desire to ensure complete devirtualization before processing a new I/O request.

53. Regarding claim 21, Bugnion teaches that the virtual machine monitor temporarily stops the operating system by emulating the I/O device as being in a "busy" or "device not ready" state (col 3 lines 8-10).

54. Regarding claim 22, Bugnion and Kozuch do not teach that the virtual machine monitor bounds the amount of time the operating system processing is temporarily stopped.

55. It would have been obvious to one of ordinary skill in the art at the time of the invention that the VMM bound the amount of time that the OS is stopped. One would be motivated by the desire to ensure that the OS be stopped indefinitely.

56. Regarding claim 23, Bugnion and Kozuch do not teach that the VMM logs I/O accesses by the operating system to the I/O device during devirtualization, and replays the log to the device after devirtualization, whereby the I/O accesses by the operating system are deferred during the devirtualization of the I/O device.

57. Bugnion does teach that requests must be intercepted and remapped when virtualization of the I/O device occurs (col 2 lines 57-59). It would have been obvious to one of ordinary skill in the art at the time of the invention to that some sort of logging and playback must occur when the device is devirtualized. One would be motivated by the desire to track any requests that main occur during devirtualization.

58. Regarding claim 24, Kozuch teaches that the virtual machine monitor waits for I/Os initiated by the virtual machine monitor's driver for the I/O device to complete, and for all expected interrupts from the device to arrive, before ceasing device emulation ([0027] lines 7-11, wherein the VM must be determined to be quiescent).

59. Regarding claim 25, Bugnion and Kozuch do not teach re-directing interrupts from interrupt handlers in the-virtual machine monitor to interrupt handlers in the operating system.

60. Bugnion teaches the I/O device interrupts are directed to the virtual machine monitor during and after the virtualization of the I/O device (col 11 lines 48-49). It would have been obvious to one of ordinary skill in the art at the time of the invention, that the interrupts be redirected back to the OS during devirtualization. One would be motivated by the desire to restore the system back to its original state.

61. Regarding claim 26, Bugnion and Kozuch do not teach configuring the hardware so the accesses by the operating system to the I/O device no longer trap to the virtual machine monitor.

62. Bugnion teaches configuring the hardware to trap I/O accesses, and enabling the virtual machine monitor to emulate the I/O device in response to the traps (col 11 lines 31-34). ). It would have been obvious to one of ordinary skill in the art at the time of the invention, that the I/O device no longer trap to the virtual machine monitor during devirtualization. One would be motivated by the desire to restore the system back to its original state.

63. Regarding claim 27, Bugnion and Kozuch do not teach that wherein the I/O device has multiple modes of operations; wherein the virtual machine monitor determines the mode of the I/O device prior to commencing devirtualization; and

wherein the virtual machine monitor restores the determined mode of the operation after devirtualization.

64. It would have been obvious to one of ordinary skill in the art at the time of the invention that I/O devices have multiple modes of operations. It also would have been obvious to restore a previous mode of operation after devirtualization. One would be motivated by the desire to ensure that the devirtualization proceeded transparently as indicated by Bugnion (col 6 lines 17-20).

65. Regarding claim 28, Kozuch teaches that the I/O device is virtualized at runtime again after having been devirtualized at runtime ([0031]).

66. Regarding claims 38-46, they are the computer claims of claims 17, 20-24, and 26-28 above. Therefore they are rejected for the same reasons as claims 17, 20-24, and 26-28 above.

67. Regarding claims 56-66, they are the article claims of claims 17, 19, 20-24, and 26-28 above. Therefore they are rejected for the same reasons as claims 17, 19, 20-24, and 26-28 above.

Art Unit: 2195

**Conclusion**

68. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric C. Wai whose telephone number is 571-270-1012. The examiner can normally be reached on Mon-Thurs, 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng - Ai An can be reached on 571-272-3756. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

EW

  
**MENG-AI T. AN**  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER